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The use of fresh cadaveric cow brain as an experimental model for Sylvian fissure microdissection

An experimental model for Sylvian fissure microdissection

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Abstract

Aim: The aim of this study was to evaluate the feasibility of using fresh cow brain as a training model for microsurgical dissection of Sylvian fissure. Micro-neurosurgical intervention to the brain includes many surgical activities performed by using metallic instruments to the vascular and/or parenchymal structure of the nervous system. For this purpose, an experimental micro-neurosurgical brain model using fresh cadaveric uncovered cow brain was used in the evaluation of the feasibility as a training model. Material and Method: Experimental micro-neurosurgical activities in this study were performed under the operating microscope. Bilateral Sylvian cisterns of the fresh cadaveric cow brain were used as an interested area for this experiment. The dissection and separation was continued reaching down to the floor of the cistern, and total dissection of the middle cerebral artery inside the cisternal space was performed. The suitability of a cow brain as a training model for Sylvian fissure microdissection was evaluated as three groups; bad, good, and perfect. Results: Ten uncovered fresh cadaveric cow brain were used in this experimental feasibility study. The suitability of the experiment for training model was evaluated as bad in (2) 20% of the fresh cadaveric cow brains. The suitability was found as good in (6) 60% of the procedures. In the remaining (2) 20% of the brain dissection, the suitability of the experiment was evaluated as perfect. Discussion: To sum up, safe surgical interventions require protecting of the brain tissue and neurovascular structures. Thus, it's extremely necessary to perform dissection and separation on neurovascular on training models before real practices on humans. Cow's Sylvian cistern training model is feasible as shown in this experimental study. We believe that this training model will contribute to the practical micro-neurosurgery in various terms primarily, it helps to protect of neurovascular tissue. Additionally, it provides adequate performance for the microsurgical intervention around the Sylvian cistern.

Keywords

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Introduction

Sharp and blunt dissection of the delicate neuroanatomical structures of the brain is commonly used in micro-neurosurgical practice. Some adjuvant-sophisticated systems may be used in the determination of the lesion location within the brain tissue. On the other hand, an adequate microsurgical technique including dissection, separation, and retraction of the sulcus and/or cisternae is extremely important in the prevention of bruised effect of metallic microsurgical instruments. The Microsurgical technique enables the neurosurgeon to dissect and expose the intracranial lesion such as aneurysms, vascular malformations and tumors in a natural pathway within the subarachnoidal cisterns and sulcus [7]. Specifically, stereoscopic magnification with deep zoom and sharp focus provides the neurosurgeon adequate view of the pathology [1]. Arachnoid dissection is the real key to successful aneurysm operations [7, 8]. Knowing the anatomy of subarachnoid cisternae is also important.

Specific micro-neurosurgical techniques such as proper use of the operative microscope, holding and grasping of the micro-neurosurgical instruments, a proper microsurgical technique of the opening of the arachnoid membranes, safe and delicate neurovascular dissection, and careful and proper micro-drilling of the cranial base bones should be learned before operating on a patient [1-7]. Theoretical knowledge, practical techniques, and microsurgical operative disciplines for the extreme protection of the delicate brain and related structures located within the cranium are mainly provided during the residency years of neurosurgical education [4, 5, 7].

Many neurosurgeons interested in microneurosurgery try to gain some additional and advanced progress in the improving their micro-neurosurgical ability including brain protection and delicate micro-neurosurgical techniques in laboratory training setting [2, 4, 5, 7]. Spending of time in experimental microsurgical laboratory to practice some microsurgical models such as dissection and suturing of the rat external carotid artery, dissection and evaluation of the abdominal vena cava of rats, suturing of the plastic glove materials by using microforceps under the operating microscope, drilling and dissection of the some cadaveric bone materials are essential improving and gaining of advanced micro-neurosurgical practical techniques [2, 4, 5, 7].

This experimental study aimed to evaluate the feasibility of cow Sylvian cistern dissection in the training of Sylvian cistern dissection. Experimental findings, difficulties, practical methods, and suggestions were discussed in line with the existing literature.

Material and Method

Experimental micro-neurosurgical activities in this study were performed under the operating microscope. Proximal and distal part of the lateral sulcus (Sylvian cistern) of the fresh cadaveric cow brain was used as an area of interest for this experiment. The uncovered cow brains were positioned laterally on the operating platform (Figure 1). The microsurgical dissection procedure was started from the distal part of the Sylvian cistern of the cow brains in the opening of the cisternal space (Figure 2). The superficial direction of the origin of the middle cerebral artery from the internal carotid artery was used in the

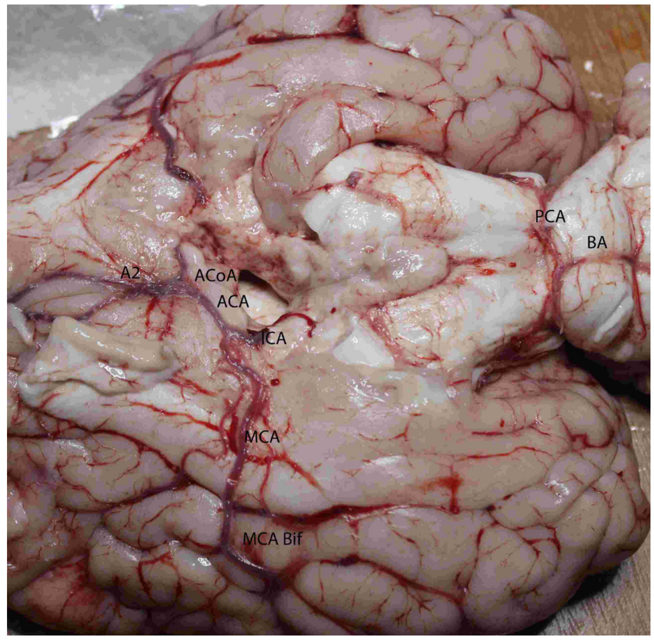

Figure 1. This figure shows the basal cerebral arteries (BA. basilar artery, PCA. Posterior cerebral artery, ICA. internal carotid artery, ACA. anterior cerebral artery, ACoA. Anterior communicant artery, A2. distal anterior cerebral artery, MCA. middle cerebral artery, MCA Bif. Middle cerebral artery bifurcation).

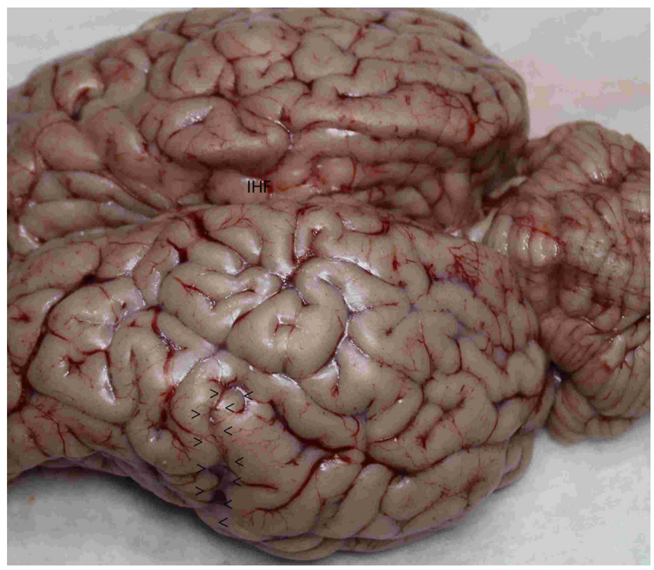

Figure 2. The appearance of the distal Sylvian cistern (IHF. interhemispheric fissure, arrows shows the Sylvian cistern).

identification of the location of the Sylvian cistern. The microsurgical dissection of the Sylvian cistern is shown in Figure 3. Microscissors was used for cutting off the delicate arachnoid membrane overlying the Sylvian cistern. Following the ten millimeters opening of the arachnoid membrane the dissection directed through the branch of the middle cerebral artery located inside the Sylvian cistern.

The dissection and separation was continued along the proximal part of the middle cerebral artery. The bifurcation of the middle cerebral artery could be seen in the middle of the Sylvian cistern (Figure 4). The main trunk, bifurcation, temporal and frontal branches of the middle cerebral artery was identified. The Sylvian fissure on the opposite side was dissected the same way. The suitability of the experimental process for micro-neurosurgical training model was evaluated within three groups as bad, good, and perfect.

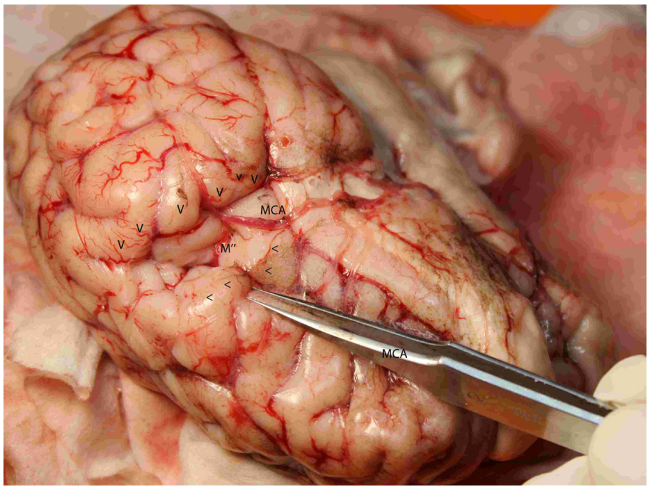

Figure 3. The appearance of dissected Sylvian cistern (MCA. middle cerebral artery main trunk, M". Post bifurcation segment of the middle cerebral artery, arrows show the borders of the Sylvian cistern).

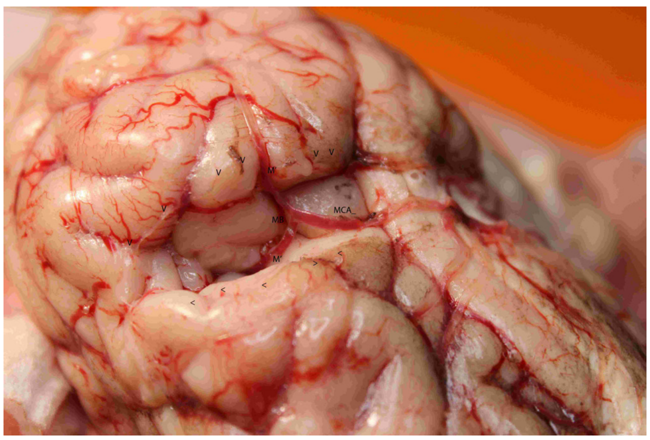

Figure 4. The appearance of the middle cerebral artery inside the Sylvian cistern (MCA. middle cerebral artery main trunk, MB. bifurcation of the middle cerebral artery, M'. Post-bifurcation segment of the middle cerebral artery, arrows show the borders of the middle cerebral artery).

The criteria for perfect, good and bad results were described as follows; In perfect result, the surgical specimens show no pial injury, cortical laceration, and separation following the surgical intervention. In good result, pial injury can be detected, but there is no cortical laceration. In bad result, pial and cortical injury, laceration and separation may be present.

Results

Ten uncovered fresh cadaveric cow brain were used in this experimental feasibility study. The specimens were positioned with resembling of real operations to the middle cerebral artery. Microscissors, micro bayonet and the tip of the metallic suction tube were used in the dissection of the cistern. The sharp edge of the microscissors was used to cut and open the arachnoid membrane. Our experiences revealed that the arachnoid membrane of the cow brain is more delicate and thin in comparison with the arachnoid membrane of the human brain. It is necessary to extremely pay attention during the cutting of the arachnoid membrane in the avoiding of the neural tissue injury. Cottonoids may be used to separate brain tissue to protect from the blunt corner of the microsurgical instruments such as micro bayonet and microscissors. A sufficient microsurgical technique should not cause any pial tissue injury.

The identification of the middle cerebral artery is easy to recognize and dissection. On the other hand dissection of the venous structure is difficult in cadaveric cow brain specimens. The suitability of the experiment for training model was evaluated as bad in (2) 20% of the fresh cadaveric cow brains. The suitability was found as good in (6) 60% of the procedures. In the remaining (2) 20% of the brain dissection, the suitability of the experiment was evaluated as perfect.

Discussion

Regional microsurgical anatomy includes sulcus and cisterns. Microsurgical instruments should be well-known and recognized for a safe micro-neurosurgical intervention and gained practice [3]. It is also crucially important the using of these instruments with appropriate microsurgical technique [3]. Sylvian cistern is the most well-known neuroanatomical structure among the neurosurgeons. This cistern is transitional between the basal cisterns and the subarachnoid space over the convexities [7]. Sylvian cistern is a convenient corridor in the reaching down to the cranial base such as sellar region, olfactory groove, optic chiasm, and carotid-cavernous structures. On the other hand, the most medial and inferior extent of the Sylvian cistern is at the origin of the middle cerebral artery from the internal carotid [7]. The Sylvian cistern contains the middle cerebral artery and the origin of the lenticulostriate, temporopolar and anterior temporal arteries, the middle cerebral artery bifurcation and the origins of the major branches [7]. The superficial and deep Sylvian veins are also within the cistern [7]. Dissection of the Sylvian cistern should be started with the opening of the arachnoid membrane overlying the cisternae distal to the middle cerebral artery bifurcation and superior to the temporal veins. After finding the distal part of the middle cerebral artery branches, the dissection should be directed to the bifurcation and proximal part of the middle cerebral artery. Separation and retraction of the frontal and temporal structures are necessary for the keep progressing down to the proximal part of the cistern.

Before a real operation performing on human beings, it is extremely necessary that understanding of the capability of some metallic surgical devices to be used in the micro-neurosurgical intervention. It is required for the person to develop his or her own abilities and to create integrated personal surgical techniques for the appropriate protection of brain [1, 5, 6]. It is extremely imperative that surgical techniques should be repeated several times on appropriate models to maintain and terminate microsurgical interventions successfully [6]. Vascular end-to-end, end-to-side, side-to-side anastomosis, aneurysm clipping, and Sylvian fissure dissection may be practiced using similar training models [1, 2, 4, 5].

In this experimental model, fresh cadaveric cow brains were evaluated for its suitability as a training model for Sylvian cistern microsurgical dissection. An appropriate and successful model should have some similarities with the represented human organ or system. Ethical issues with live models in addition to the above disadvantages also pose problematic limitations in experimental practice.

There are a few differences between the human and cow brain. The human brain is larger in size and shape when compared to the cow's brain. The cow brain does not have as many gyri and sulci when compared to human brain. A cow's brain is elongated in shape, whereas a human brain is rounded. The human brain is not only larger but also heavier than a cow's brain. However, there are some differences between human and cow brains, but almost all mammals brain are similar. Except for some anatomical differences, the location of the interhemispheric sulcus and the arachnoid membrane have the same characteristic feature between human and cow brain. In this experimental model, the similar microsurgical instruments were used during dissection, separation, and distraction of the brain. Micro scissor, the tip of the micro-suction tube and micro bayonet were used in the dissection and separation of the neural and vascular structures. It can be seen some advantages when we evaluate the cow brain under the light of the parameters detailed above. Because the fresh cadaveric cow brain is not a living model, there is no need for local ethical committee permission. So there are no ethical restrictions in this model in comparison with live models. In addition to ethical convenience and the intense similarities with the human brain, the fresh cadaveric cow brain was used in this study. When we think of all these features together, the cow brain should be regarded as a suitable model in the experimental micro-neurosurgical training for Sylvian cistern dissection.

Sulcus and/or cisternae dissection and separation in the microsurgical brain operation is commonly used in micro-neurosurgical practice. Performing of the finely locate the lesion using neuroradiological images can be performed during the surgical intervention. Following the cisternae dissection and/or splitting of the brain parenchyma, operative corridor may be reached down and pathology localized or located inside the Sylvian cistern. Repetitive training of the Sylvian cistern dissection in the models like ours is crucial in improving safety in microsurgical intervention. This experimental study revealed that cow brain is a suitable model for training in Sylvian cistern dissection. The suitability was found as good in (6) 60% of the procedures and perfect in (2) 20% of the procedures. Cow Sylvian cistern dissection may be used for training in Sylvian cistern and middle cerebral artery dissection.

Conclusion

To sum up, safe surgical interventions require protecting of the brain tissue and neurovascular structures. Thus, it's extremely necessary to perform dissection and separation on neurovascular on training models before real practices on humans. Cow's Sylvian cistern training model is feasible as shown in this experimental study. We believe that this training model will contribute to the practical micro-neurosurgery in various terms primarily, it helps to protect neurovascular tissue. Additionally, it provides adequate performance for the microsurgical intervention around the Sylvian cistern.

Scientific Responsibility Statement

The authors declare that they are responsible for the article's scientific content including study design, data collection, analysis and interpretation, writing, some of the main line, or all of the preparation and scientific review of the contents and approval of the final version of the article.

Animal and human rights statement

All procedures performed in this study were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. No animal or human studies were carried out by the authors for this article.

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Conflict of interest

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